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FINAL REPORT

NASA Research Grant Nsg-293
to Iowa State University

1. Summary and conclusions.

The belief stated in the Proposal (May 1962, p. 2) that "significant improvements in both the theory and application of elliptic integrals will come from a thorough study of the function R " has been justified in the papers listed below. Paper (1) shows how the theory is simplified; paper (2) gives improved computational methods; and report (6) and paper (7) present extremely compact tables of integrals for practical use, along with reduction formulas and numerical tables. In particular, the last paper shows how three formulas using the R -function are able to serve the same purpose as some seven hundred of the formulas in a standard handbook of elliptic integrals.

Study of the R -function has also disclosed an unsuspected connection between hypergeometric functions and the theory of mean values. Paper (3) shows that the notion of a homogeneous mean value can be greatly extended without losing any important properties, and paper (5) applies the theory to the problem of deriving useful inequalities for hypergeometric functions.

2. Publications.

Acknowledgment of partial support by NASA Grant Nsg-293 has been made in the following papers:

- (1) B. C. Carlson, Normal elliptic integrals of the first and second kinds. *Duke Mathematical Journal* 31 (1964) 405-419.
- (2) B. C. Carlson, On computing elliptic integrals and functions. *Journal of Mathematics and Physics* 44 (1965) 36-51.

- (3) B. C. Carlson, A hypergeometric mean value. Proceedings of the American Mathematical Society 16 (1965) 759-766.
- (4) B. C. Carlson and W. H. Greiman, The Fourier series of Gegenbauer's function. Duke Mathematical Journal, accepted for publication.
- (5) B. C. Carlson, Some inequalities for hypergeometric functions. Proceedings of the American Mathematical Society, accepted for publication.
- (6) W. J. Nellis, Tables of elliptic integrals. NASA Contractor Report NASA CR-289, August 1965. The next item is a condensed and revised version of this report.
- (7) W. J. Nellis and B. C. Carlson, Reduction and evaluation of elliptic integrals. Mathematics of Computation, accepted for publication.

3. Comments.

I should like to express my appreciation for NASA's support of this research. The project has, I think, been successful, and the work is going to be extended under other auspices. My own experience has convinced me of the value of diversity in the possible sources of government support for small research projects; I have acquired a considerable respect for NASA's attitude towards basic research, and I hope it will continue to expand its activities in this field.

Respectfully submitted,

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Principal Investigator